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At the 16 May '48 session of the scientific soviet of the Institute of Machine Studies, USSR Academy of Sciences, there took place the public defense of the doctoral dissertation of former scientific co-worker I. Ya. Akushskiy on the theme: "Calculating-Analytical Machines and Their Application to Mathematical Problems". Akushskiy's dissertation was devoted to a problem which possesses real significance for the present-day stage of development of science and technology. As is known, the solving of a series of complicated scientific problems in the field of technology and natural science is connected with the execution of a great volume of computational labor. The slowness of execution of tremendous computational processes, which is aggravated by increasing demands for high accuracy of calculations, retards the tempo of scientific-research works. In connection with this, there has arisen the problem of creating a new branch of technology - namely, computational or calculational technology which is called upon to mechanize the numerical solution of various mathematical problems. At the present time this technology already possesses a rather considerable quantity of various mechanisms (link, toothed, etc.) which execute the most simple arithmetical operations. However, these mechanisms do not satisfy present-day demands of accuracy. In connection with this, plans have been drawn up in recent years to create mechanisms and machines in which "discrete" calculations (binary system, etc) are effected and where the degree of accuracy is theoretically unlimited. Next come calculating-analytical machines which operate on the punched-card principle of "picking up" numbers. These machines possess the ability of carrying out entire calculating cycles with great effectiveness and perfect independence.

I. Ya. Akushskiy's dissertation was devoted also to an investigation of these machines. He graphically showed that the employment of calculating-analytical machines only for executing the simplest operations of

calculation and statistics is a direct consequence of feeble efforts in studying these machines. Proceeding from the position that since the solution of every mathematical problem can be reduced to a combination of basic arithmetical operations in definite sequence the machine would not be required to deal with complicated processes initially hence the author indicated the possibility of applying calculating-analytical machines to the solution of problems in mathematical analysis.

In his study the author set up two basic problems: 1) the investigation of existing calculating-analytical machines in the direction of profound analysis of the mechanical operations that are executable by a machine; and the development of potentialities, hidden in a machine, to execute problems of mathematical analysis. 2) The development of methods for solving mathematical problems amenable to mechanized computational processes, taking into account the specific peculiarities of the mechanical operations that can be executed by a machine.

The dissertation consists of two parts. In the six chapters making up the first part of the dissertation the main role is concerned with the disclosure of the "principle" ("theoretical") moments (mechanical) in the construction and operation of machines with a calculating-analytical complex, and a study is made of the group of basic operations that are executed by every machine. Also here are discussed the basic principles governing punch-card operation of "picking off" numbers, the construction of the punching block; the following operating parts of machines are investigated: reproducer, sorting machine, distributing machine, tabulator, and duplicating automat. The dissertation discloses, for each of these machines in turn, the group of problems which are solved by the machine in question for various interconnections of its basic directing and executing ring sections.

The second part of the dissertation, which consists of five chapters, exposes various methods of solving basic mathematical problems with the help of calculating-analytical machines. The first chapter contains an analysis of the operations of the tabulator of strictly vertical action.

After investigating the nature of summing operations of such a tabulator, the dissertation goes on to analyze the operation of the selectors. As one of the applications of this analysis, the method of diagonal summation is discussed which in further paragraphs of the chapter is developed to show how it solves problems of numerical calculation of differential equations, interpolation, etc.

The second chapter analyzes the operations which are executed on the tabulator having vertical-horizontal action. The concept of an operational cycle is introduced, as it applies to the tabulator, and a number of operation cycles are set up for solving several problems. Another operational cycle is introduced which carries out on the tabulator multiplication, the cycle being based upon the idea of representing multipliers in a binary system. The inclusion of this process of multiplication as an element into the composition of the operational cycle now permits one to construct cycles for realizing a wide circle of problems that can be solved on the machine. Cycles are shown that solve linear difference equations and that integrate differential equations and solve systems of linear algebraic equations, etc.

The third chapter is devoted to the application of the introduced method of binary multiplication to the execution, on the tabulator, of one of the basic mathematical operations-namely the calculation of the sum of products.

The methods of "discharge" multiplication (the method of additional cards, etc) for calculating the sums of binary, ternary, and quaternary products are discussed at length. Here also is introduced the process of assigning a functional dependence with the aid of a special commutation of the selector.

The fourth chapter discusses the application of the methods of the third chapter to certain mathematical problems. The following problems are taken up: 1) The solution of systems of linear algebraic equations; 2) operations on matrices and vectors; 3) representation of a vector equation in the form of a polynomial; 4) harmonic analysis.

The fifth chapter is devoted to the construction and method of setting up mathematical tables on punch cards and processes of effective obtaining, with the aid of machines, of the necessary values of the functions from these tables.

The newness of the problem and the originality of its statement and solution caused much interest among the participants at the session. Opponents were acting member of the Academy of Artillery Sciences N. I. Pchel'nikov, corresponding-member of the Academy of Sciences USSR I. S. Bruk, and doctor of mathematical scientists L. V. Kantorovich. They characterized the dissertator as one of the most prominent specialists in computational technology and pointed out that the defended dissertation sums up the results of many years of I. Ya. Akushskiy's efforts and that the results of individual stages in the work of the dissertator at the present time have already been utilized with great effect in the practical work of a number of scientific plans of the country for solving important problems of technology.

After acknowledging the work of the dissertator as a valuable contribution to the development of our native computational technology, the scientific soviet conferred the degree of doctor of technical sciences upon I. Ya. Akushskiy.

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